UCRL-JC-125243 Abs

Spectroscopy of thin foils heated with ultra short laser pulses

Ronnie Shepherd, Bruce Young, Dwight Price, Al Osterheld, Rosemary Walling, Gary Guethlein, Richard More, and Richard Stewart, Atomic and Plasma Physics Division, Lawrence Livermore National Laboratory, P.O. Box 808, Livermore Ca., 94550,
and
Takako Kato, National Institute for Fusion Studies, Nagoya, Japan.

The technique of creating high energy-density plasmas using short pulse laser solid interaction is a developing field. A common goal of many researchers is producing the highest possible temperature with little or no material expansion. A significant limiting effect on the maximum temperature achieved in the interaction is the cooling rate. In the present set of experiments, we examine the competing cooling due to expansion versus thermal conduction.

The experiment is done using thin aluminum foils of successive thickness ranging from 250 Å to 1250 Å. The foils were heated with a 400 nm, 150 fs (FWHM) ultra short pulse laser. The laser energy was approximately 200 mJ and was focused to a spot size of 3 μm, resulting in a peak intensity of 1.9 x 10^{19} W/cm^2. The prepulse to main pulse contrast was determined to be better than 10^{-7}. The $1s^2$-1s2p, $1s^2$-1s3p transitions in He-like aluminum and the 1s-2p transition in H-like aluminum were temporally resolved using a 900 fs x-ray streak camera. Additionally, the Li-like and He-like satellites were temporally resolved. Using these data, the effect of target thickness (and hence thermal conduction) is used to examine the rate of cooling in the plasma. A simple model is used to interpret the experiment. We present the data and the preliminary findings from this study.

Work performed under the auspices of the U.S. Dept. of Energy by Lawrence Livermore National Laboratory under contract W-7405-ENG-48.